



## Traffic Prediction with Convolutional Long Short-Term Memory

Peled, Inon; Pereira, Francisco C.; Winther, Ole

*Publication date:*  
2018

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Peled, I., Pereira, F. C., & Winther, O. (2018). *Traffic Prediction with Convolutional Long Short-Term Memory*. Poster session presented at hEART 2018: 7th Symposium of the European Association for Research in Transportation, Athens, Greece.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



# Traffic Prediction with Convolutional Long Short-Term Memory

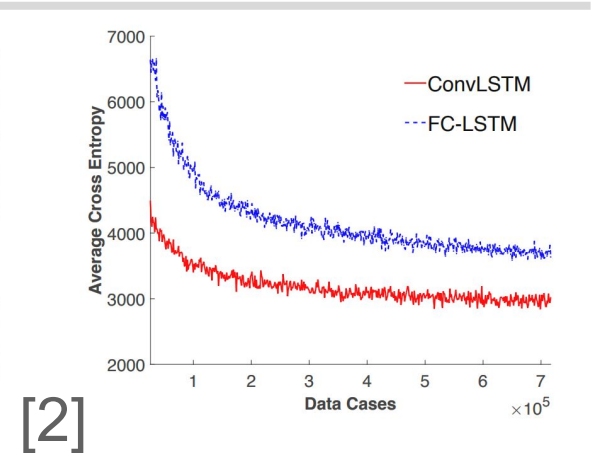
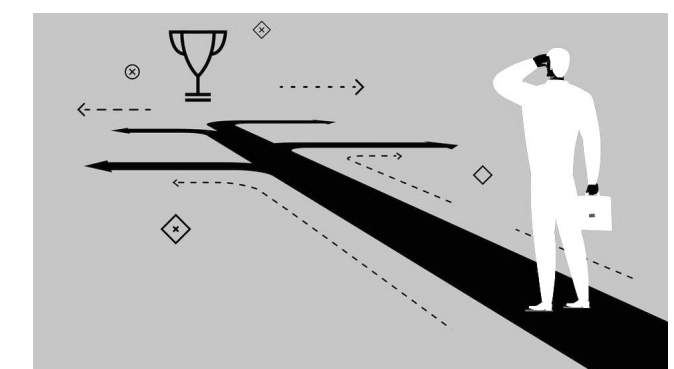
Inon Peled, Francisco C. Pereira, Ole Winther

## Background and Motivation

**Accurate prediction of traffic** admits many benefits: reliable travel planning, early detection of congestion, effective response by road practitioners, and more.

Recurrent Neural Networks (RNNs) with Long Short-Term Memory (LSTM) have been successfully applied to **time series prediction** [1]. Recently, [2] showed that *Convolutional LSTM (Conv-LSTM)* outperforms classic LSTM in predicting time series data on a **2-dimensional spatial grid**.

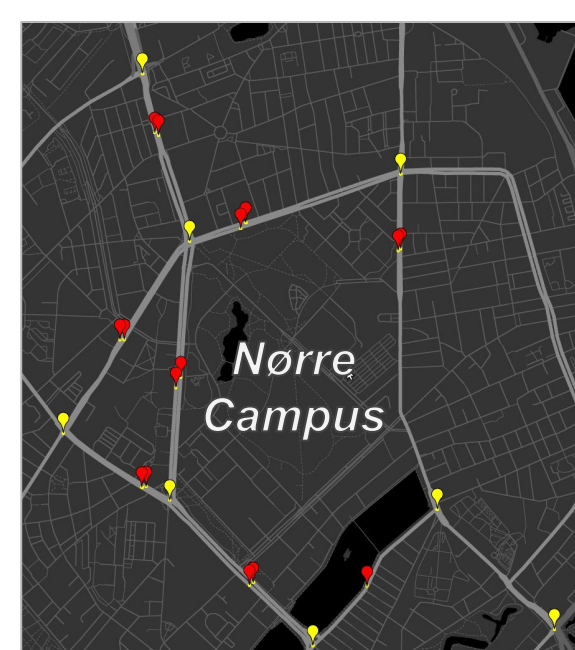
In this work, we study the applicability of **Conv-LSTM** to prediction of traffic on a road network.



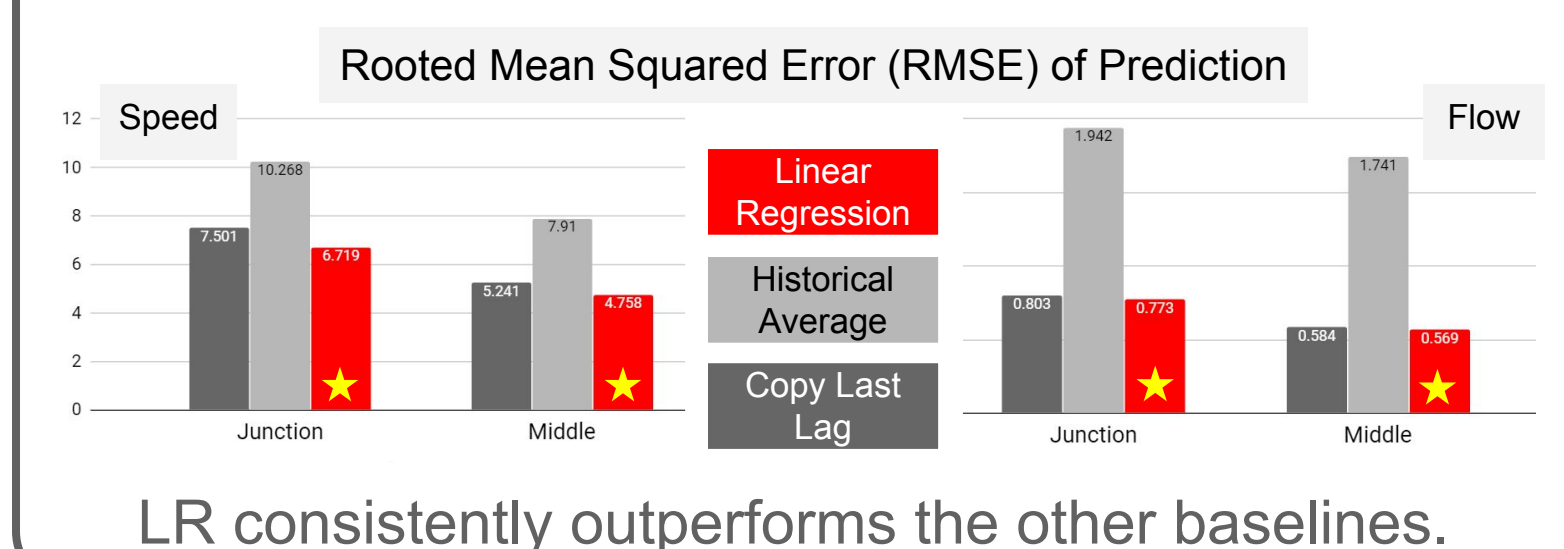
## Data

**Speeds** and relative **flows** from Android devices.

- Around University of Copenhagen, January-June 2015.
- Averaged every 5 minutes in several **middle-of-roads** and **junctions**.
- **Goal**: predict speed and flow in next 5min, given last hour.
- January..May for training, June for testing.

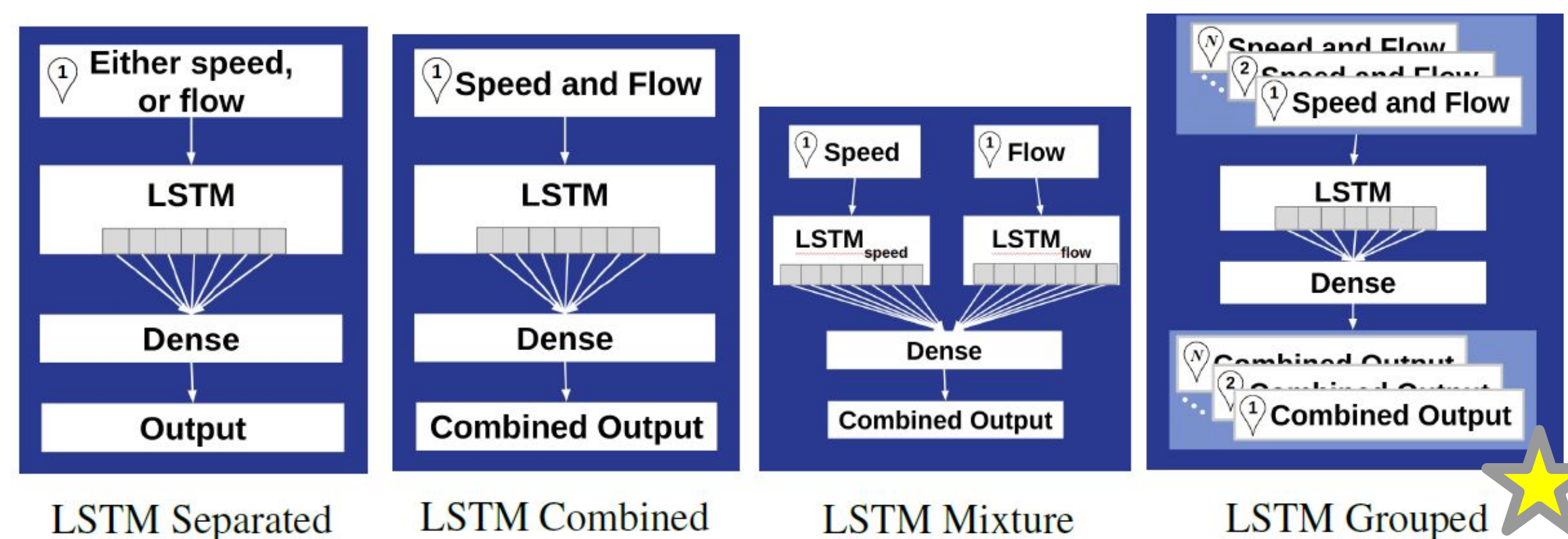


## 1) Baseline Models

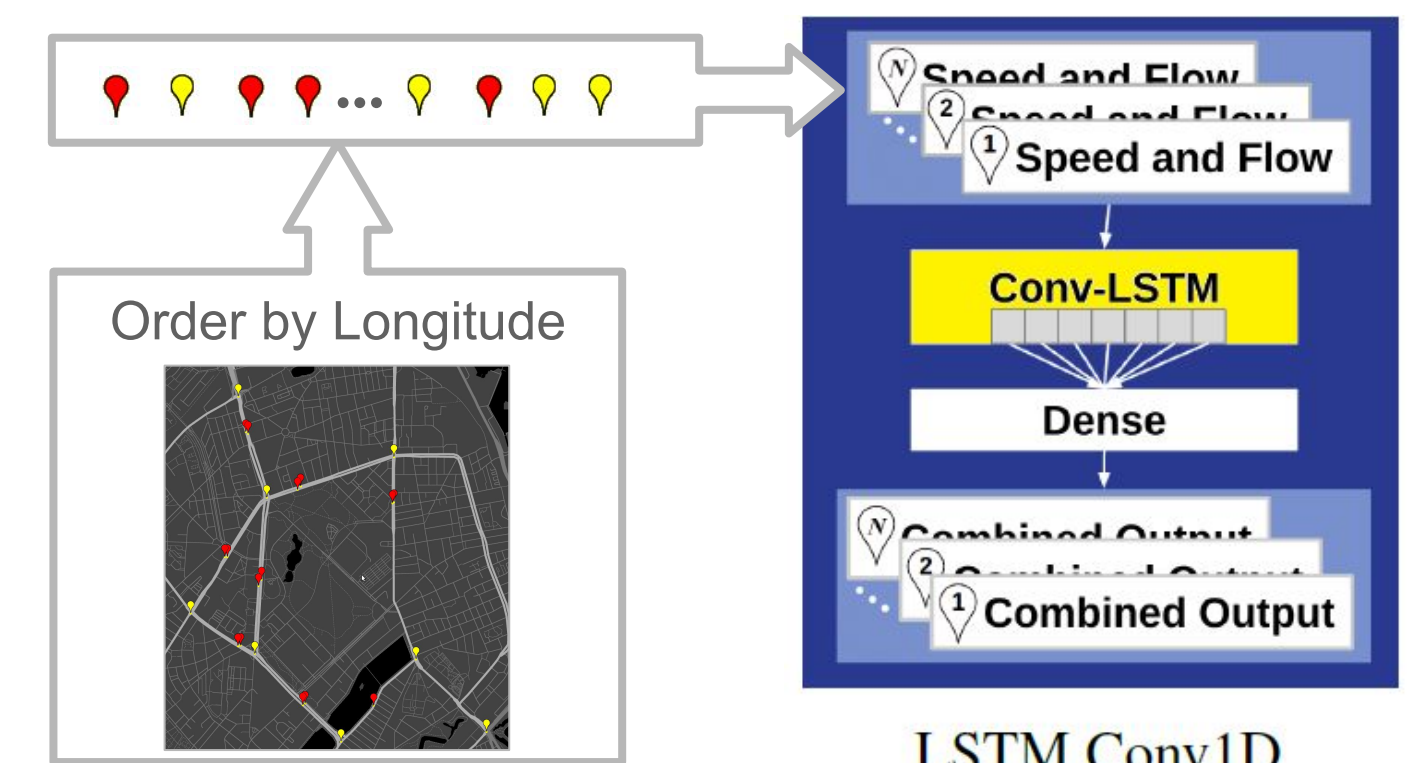


## 2) RNN Models with Classic LSTM

Iteratively improve architecture, with exhaustive search for best hyper-parameters.



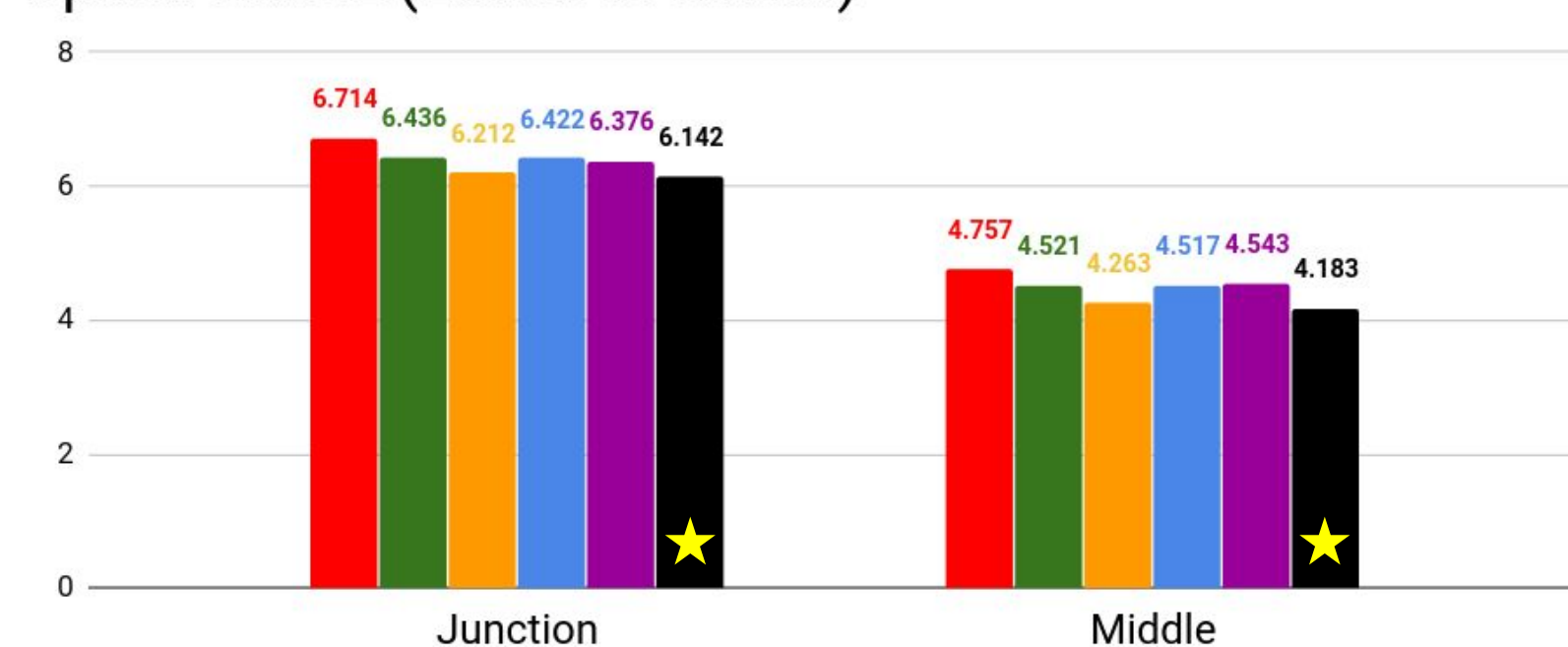
## 3) Conv-LSTM, 1-Dimensional Grid



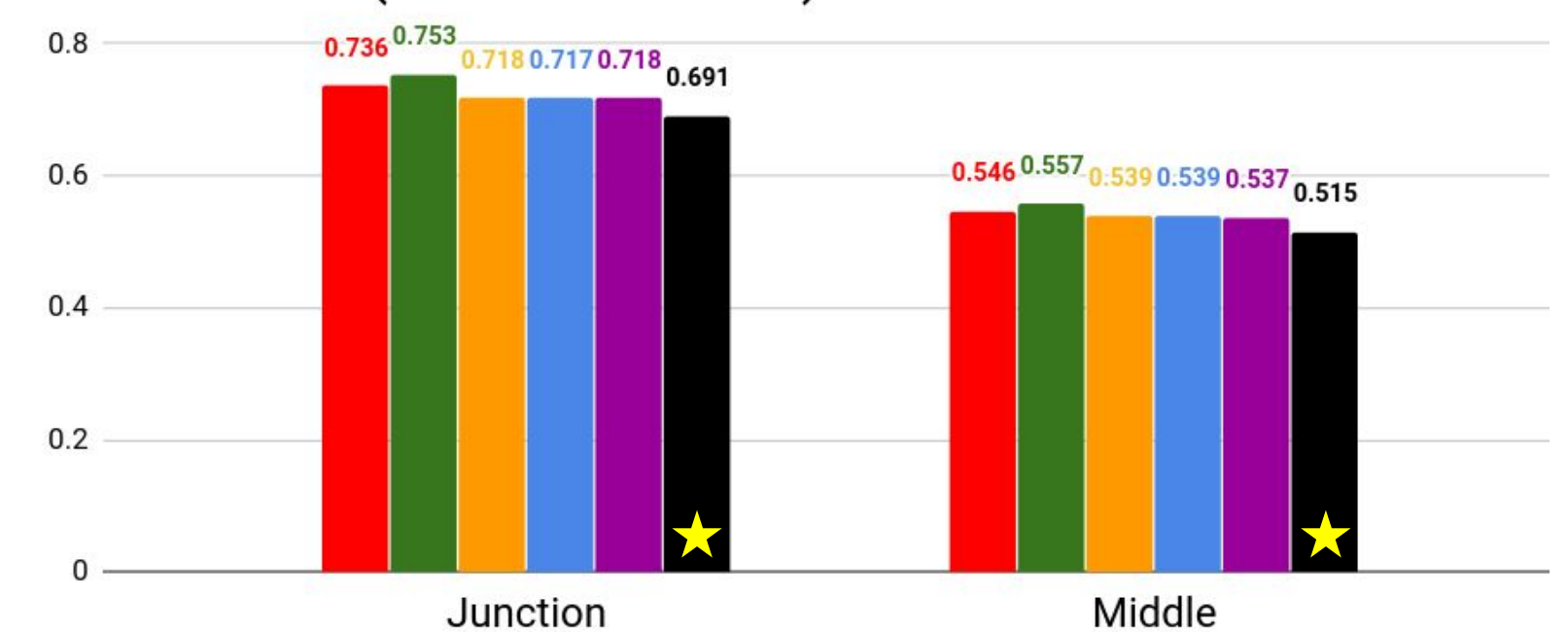
A 2D grid would otherwise be sparse, with opposing traffic directions in same cells.

## Results

Speed RMSE (Lower is Better)



Flow RMSE (Lower is Better)



Conv-LSTM 1D outperforms all other models.

Consistent results also under Mean Absolute Error (MAE), Pearson Correlation Coefficient  $\rho$ , and Coefficient of Determination  $R^2$ .

## Conclusions

1. Similarly to LR, RNNs perform better in *middle-of-roads* than in *junctions*.
2. Unlike LR, RNNs benefit from *combining* flow and speed.
3. **Conv-LSTM** takes advantage of **spatio-temporal correlations**, and outperforms classic LSTM for traffic data too.

## References

- [1] "The unreasonable effectiveness of recurrent neural networks", <http://karpathy.github.io/2015/05/21/rnn-effectiveness/>.
- [2] Chen et al., "Convolutional LSTM network: A machine learning approach for precipitation nowcasting," CoRR, vol. abs/1506.04214, 2015.